

PhD course: Probabilistic Risk Analysis (FBOM095)

Risk analysis has become an increasingly important part of civil and environmental engineering. It has a wide range of applications, e.g. in transportation, remediation of contaminated land, protection of drinking water resources, ground stability, and tunneling. Risk analysis not only includes the estimation of risk levels, but also provides a basis for decisions regarding what are the most relevant actions to be taken to reduce and control risks. In some cases, risk assessment is also part of the regulatory framework and required as a basis for design, construction and performance of technical systems.

Risk analysis is an inherently complex and multi-dimensional concept, since it involves the combination of probability and consequence of unwanted events and is closely connected to the evaluation of risk with respect to risk tolerability and alternative actions to reduce and control risks. Probabilistic risk analysis (PRA) is a quantitative concept and thus involves quantification of probabilities and consequences. A major issue in PRA is the understanding of uncertainty and how it can be modeled mathematically using probability.

In this doctoral course we will:

- Present the basic concepts of PRA and uncertainty modeling.
- Present Bayesian and classical statistical inference methods.
- Apply probabilistic methods for modeling uncertainty.
- Apply logic tree models (fault trees, event trees, decision trees).
- Apply Monte Carlo simulation.
- Introduce the concept of Bayesian Value of Information Analysis (VOIA)
- Present methods for expert judgments.
- Work on project assignments.
- Present our findings at a seminar.

The course will be a mix of lectures from the course leaders, presentations of assigned sections of the course literature¹ by the participants, and seminars on project assignments. The participants will, in groups, identify a task related to their current research and perform a probabilistic risk analysis on this task.

The course is worth 5 HE (higher education) credits (högskolepoäng).

At the seminars, the participants will show how their projects are progressing. The seminars also provide an opportunity for students to ask questions and for the teachers to give feedback and to talk about topics related to the methods that students have selected for their projects. The course ends with a 3-hour seminar at which students are presenting their projects.

The purpose is that after completing the course the participants should be able to:

- Perform a probabilistic risk analysis of an engineering research problem
- Be able to critically review probabilistic risk analyses
- Be able to perform uncertainty analysis of risk models

¹ Bedford, T, Cooke, R. (2001) Probabilistic Risk Analysis. Foundations and methods. Cambridge University Press. In addition, lecture notes, papers and short excerpts from other publications will be handed out by the lecturers.

The schedule of the course is presented below:

Date	Time	Location	Activity
24 Sept	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Ch 1. Introduction to PRA (LR, TN) • Ch 2. Uncertainty analysis (LR, TN) • Ch 3. Probabilistic methods (TN)
29 Sept	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Ch 3. Probabilistic methods cont. (TN) • Introduction to project assignments (LR, TN, all) • Ch 4. Statistical inference (TN)
6 Oct	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Ch 6-7. Fault tree and event tree analysis (participants) • Examples of application of fault tree and event tree analysis (AL, LR) • Progress of projects (all)
20 Oct	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Ch 10. Expert opinions (participants + JN) • Progress of projects (all)
12 Nov	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Ch 13. Decision theory and VOIA (TN, JN, LR + participants) • Progress of projects (all)
19 Nov	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Ch 15. Project risk management (participants) • Ch 17. Uncertainty analysis – Monte Carlo simulation (TN) • Progress of projects (all)
26 Nov	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Project seminar and wrap up of course (all)
10 Dec	9.00-12.00	Seminar room 2002	<ul style="list-style-type: none"> • Extra day, in case needed

Teachers:

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Welcome to the PRA-course,

Lars, Tommy, Jenny, Andreas